Morphemic Perseverative Blends by a Japanese Phonological Dyslexic in Reading Aloud Two-*Kanji* Compounds

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Abstract

SM, a patient with a brain tumor in the left hemisphere, exhibited the aphasic disorder of recurrent perseveration. This article documents the "morphemic carryover" perseveration that he produced while reading aloud two-*kanji* compounds, which is a theoretical possibility if a component *kanji* (morpheme) is a recognition unit in the reading process. He was also diagnosed as a probable phonological dyslexic because his reading of non-words and single characters was bad and in sharp contrast to his word reading, which was almost intact as far as familiar words were concerned. In standard dual-route reading models, it was envisaged he would persevere with words because his visual word recognition presumably relied on whole words. Contrary to this prediction, SM showed a number of perseverative blends in which an earlier-produced morpheme was carried over to be spliced with a current lexical or morphemic base. Thus SM's perseveration provides valuable information about how orthography and phonology interact while a compound word is being successfully read.

Introduction

There has been an increasing amount of literature on perseverative carryover of sublexical phonological units such as syllables or phonemes (Albert, M.L., & Sandson, J., 1986; Santo-Pietro, M. J., & Rigrodsky, S., 1986; Cohen, L., & Dehaene, S., 1998; Moses, M., Nickels, L,. & Sheard, S., 1998; Moses, M., Nickels, L,. & Sheard, C., 2004). These perseverations are frequently combined with other phonological or lexical units resulting in blends or hybrids, which are intriguing because locations of splicing may provide evidence for one or another theory of syllable constituency in linguistics (Buckingham, H.W., & Christman, S.S., 1996; Buckingham, H.W., & Christman, S.S., 2004; Buckingham, H. W., 2000).

Besides "phonemic carryover" blends, those involving higher-level units such as stems or morphemes that can be subject to visual/spoken word recognition could theoretically be witnessed, although there has been little if any investigation on this topic so far (Wells-Jensen, S., 1999). In this paper, we will focus on "morphemic carryover" perseverations exhibited by a Japanese aphasic while reading aloud morphologically complex words, mostly *kanji* compounds, in which the pronunciations of component kanji (morphograms of Chinese origin) from previously uttered words persevere onto the current morphemic bases or lexical units, producing a hybrid word reading. This morphemic perseveration can be best explained by the theories such as a multilevel interactive activation model (Zhou, X., & Marslen-Wilson, W., 1999; Zhou, X., Marslen-Wilson, W., Taft, M., & Shu,

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H., 1999) or an interactive constituency model (Tan, L.H., & Perfetti, C.A, 1997; Tan, L.H., & Perfetti, C.A., 1999; Perfetti, C.A., & Tan, L.H., 1998), which assume direct excitatory associations between sublexical orthographic units and the corresponding phonological representations in the course of visual word recognition. Assuming the ideas of these models, some deficit in the sublexical level processing may cause an earlier morpheme to persevere and pop up in a later unit. What SM exhibited was just this type of perseveration, which argues against the theory that *kanji* readers primarily rely on a whole-word level processing while reading morphologically complex words (Wydell, T. N., Butterworth, B., & Patterson, K. E., 1995).

Sublexical Process

In the study of visual word recognition and the cognitive process of reading aloud, one of the issues that has dominated the discussion concerns whether orthographic representations for constituent morphemes are directly connected to their phonological representation in the network of spreading activation. In alphabetic writing systems, it has been demonstrated the activation of sublexical orthographic units such as graphemes, bodies, and morphemes leads to the activation of corresponding phonological representations, which in turn play a crucial role in accessing word meanings (Taft, M., 1991; Taft, M., 1994; Morais, J., 2003). In contrast, in the logographic Chinese writing system, the traditional view has been that semantic recognition proceeds without mediation of phonology (Hoosain, R., 1991).

However there has been literature regarding Chinese which claims that when a person reads aloud compound words, phonological properties of constituent morphemes are automatically activated as claimed by the multilevel model and the interactive constituency model, according to which phonological activation can take place at different levels of intraword representations (for references, see above).

Likewise, according to Tamaoka (Tamaoka, K., 2005), with logographic Japanese *kanji* compounds, orthography-to-phonology links at sublexical levels may hold. He demonstrates with two experiments using homophonous *kanji* (morphemes) that constituents of two-character compounds cause automatic phonological activation during lexical decision task and word naming.

The present paper, which documents perseverations produced by a Japanese brain-tumor patient while reading morphologically complex words in Japanese, mostly two-*kanji* compounds, examines how these words are represented in a mental lexicon and in what ways this information is processed in printed word recognition and speech production. Specifically we will show that during word reading, the activated characters (morphemes) individually extend excitation to their respective phonological representations.

Case Report

SM was a 54-year-old right-handed Japanese male who suffered a left-hemisphere brain tumor in July 2003. He had obtained a high-school education and prior to becoming ill, sold building materials. An MRI revealed a large amorphous area of low and high density involving the left frontal, temporal and parietal robes. He spoke fluently and with natural prosody in spontaneous settings. His profile on the Standard Language Test for Aphasia (SLTA: a language test for a native Japanese) administered in July 2004 confirmed the clinical diagnosis of a fluent type of aphasia. His scores for the auditory comprehension and the object naming were 0% and 20% respectively.

SM's ability to read words was preserved with familiar words (100%), but the ability to read non-words was severely impaired, from which

SM was diagnosed as a typical phonological dyslexic.

Besides non-words, he failed to read single characters, both *kana* (phonograms) and *kanji* (morphograms), which in general do not stand as words in themselves. In fact, when reading these characters, he made many lexicalization errors, in which a single character was read as a legitimate word beginning with the same letter : か /ka/ → /kata/ "shoulder," た /ta/ → /tanosi-mu/ "enjoy," ね /ne/ → /ne-ru/ "sleep"; 商 /syou/ → /syou-bai/ "trade," 看 /kaN/ → /kaN-go/ "nursing," 温 /oN/ →/oN-sen/ "hot spa."

In contrast, his reading was intact for single *kanji* words : 愛 "love" → /ai/, 朝 "morning" → /asa/, 塩 "salt" → /sio/, 海 "sea" → /umi/, 花 "flower" → /hana/, 肉 "meat" → /niku/, 夜 "night" → /yoru/, 酒 "liquor" → /sake/, 恋 "love" → /koi/, 心 "heart" → /kokoro/.

Methods and Materials

Over the testing sessions, SM was asked to read aloud 120 words. Eighty two-character *kanji* compounds were selected from the set published by Fushimi, Ijuin, Patterson, & Tatsumi (Fushimi, T., Ijuin, M. Patterson, K., & Tatsumi, I.F., 1999). The other 40 were words of high familiarity (6.0-7.0; MAX=7.0) selected from the NTT Database in Amano & Kondo (Amano, S., & Kondo T., 1999). These 40 stimuli (mostly two-*kanji* words) included one morphologically complex word comprising a *kanji* and a *kana* morpheme (お茶 /o-tya/), one single-*kanji* word (舟 /fune/), and 5 three-*kanji* words that are derived by affixing two-*kanji* compounds with the adjectival suffix 的 /teki/ (e.g., 文化-的 /buN-ka-teki/).

Words were manually presented on 50mm x 80 mm white paper cards, printed black in 72-point Mincho (Japanese default) font. The words were administered once, 20 items each time. Administrations were separated at least by a week. Each item was presented individually and SM was allowed unlimited viewing time. All responses were tape-recorded and transcribed. Though SM sometimes made multiple responses to individual targets, we collected every response to examine his perseveration patterns. The data to be reported below were gathered between August and October, 2003.

Results

In each session, SM often produced recurrent type of verbal perseveration, the unintentional repetition of a response in the absence of the stimulus that initially elicited it (Sandson, J., & Albert, M. L., 1984). Because of his heavy reliance on the lexical pathway in reading as described above, it should naturally be expected he would persevere whole words even when encountering with morphologically complex words. Contrary to this prediction, his perseverations were not restricted to whole words, but rather they can be classified into three types as shown in Table 1.

Table 1

The total 42 persevrates that SM produced during the task of reading aloud 120 compound words are comprised of the follows.

(a) 18 whole-word perseverations (43%)
  i . 12 simple whole-word perseverations
  ii. 4 blends in which a past word is carried over to the current morphemic base
  iii. 2 blends in which a past word perseveres to the current word.
(b) 11 hybrids in which a morpheme of the earlier-produced word was carried over and spliced onto the component morpheme of the current target word. (26%)
(c) 13 hybrids in which an affixal morpheme of the earlier-produced word was carried over and spliced onto the current word. (31%)

Considering that SM's recognition unit could be a whole word, the perseverative hybrids in (b)

and (c) (24 items in sum; 57%) are worth special notice in that component morphemes were persevered from the successfully read words. This suggests that Japanese compound words are not unanalyzable wholes, but decomposable entities whose component morphemes individually elicit activation in the phonology.

Incidentally, most perseverations, i.e., those in (a-i), (b) and (c) satisfy the positional or slot constraint (Buckingham, H.W., Whitaker, H., & Whitaker, H.A., 1979): words and morphemes were carried over to the corresponding specific slots, and affixes persevere to the peripheral positions of words. For the blends of (a-ii) and (a-iii), which do not accord with this constraint, we have no explanation.

Morphemic Carryover

Perseveration, a common type of error associated with aphasics, has been standardly understood as a complete or partial repetition of a previously activated response that occurs when activation of a new response is abnormally weakened as compared with the earlier one (Cohen, L., & Dehaene, S., 1998; Moses, M., Nickels, L., & Sheard, S., 1998; Moses, M., Nickels, L., & Sheard, C., 2004). Thus, persistent activation from the past that has not been overcome by current activation will show up as a perseveration.

According to Buckingham et al., whole words are most frequent perseverative units, though subword units such as syllables, phonemes (Buckingham, H.W., Whitaker, H., & Whitaker, H.A., 1979), and clusters of phonemes can persevere to form blends consisting of the current target and a perseveration (Santo-Pietro, M. J., & Rigrodsky, S., 1986). These perseverations are very intriguing in that the location of splicing provides crucial information on the syllable structure in a lexicon and the roles of sublexical units in the cognitive processes involved in reading aloud.

If, as the dual-route model assumes, whole-word phonology is activated after the orthographic word recognition in a standard way, it is theoretically envisaged that subword morphemes will never persevere. However, in actual fact and contrary to this expectation, among SM's perseverations are those in which morphemes of the former successful responses are carried over and spliced onto the current base, forming perseverative blends. Table 2 presents examples of these perseverations.

Table 2

Examples of Preservative Blends (1)

	Stimulus	Pronunciation		Response	
（1）	学 校	/gak-kou/	→	/gak-kou/	(cr)
	“school”	studying-facility			
（2）	商 売	/syou-bai/	→	/syou-kou/	(pb)
	“business”	trade-selling			
（3）	病院	/byou-in/	→	/byou-in/	(cr)
	“hospital”	illness-facility			
（4）	政治	/sei-zi/	→	/byou-zi/, /byou-ti/	(pb)
	“politics”	politics-governing			

cr = correct response; pb = preservative blend

Note: *kanji* generally have multiple readings. Thus 治 as in (4) can be read as /zi/ or /ti/, hence two hybrids.

SM read the two-*kanji* compound (1) 学校, meaning "school," correctly as /gak-kou/, whereas the compound (2) 商 売 /syou-bai/ "business", presented immediately after the former, was read incorrectly as the hybrid /syou-kou/, where the pronunciation of the previous morpheme 校 /kou/ "facility" was carried over to be compounded with the current morphemic base 商 /syou/ "trade", suppressing 売 /bai/ "selling", the other component morpheme of the current word.

In (3), the morpheme /byou/ (病) persevered to splice with the following morphemic base /zi/ (治), accounting for the hybrid /byou-zi/. See other instances in Table 3:

夕刊, 労働, 奉行, and 極上 were read as preservative hybrids.

This type of blends suggests that while a compound word is being successfully read, the orthography and the phonology of component characters (morphemes) may also be automatically activated at a sublexical level, as in Figure 1.

According to the abnormal activation theory of perseveration, these blends can be accounted for by the carryover of an earlier morpheme due to the too-weak phonological activation of one component character; therefore the former replaces the latter, leading to a hybrid of the perseveration and the other component morpheme.

Derivational Words

Perseverative hybrids are not restricted only to *kanji* compounds. The example illustrated in Table 4 shows the *kana* morpheme /o/ for politeness (POL) can persevere to splice onto the subsequent target word.

Here the patient incorrectly read the stimulus (1) お茶 /o-tya/ ("tea") by sffixing its correct pronunciation with the neologistic morpheme /-garashi/. SM carried over the politeness morpheme /o/ (お), which was then prefixed to the word /ki-iro/ (黄 色) "yellow" in (5), producing the hybrid /o-ki-iro/ (お黄色). The morpheme further perseverated to be prefixed to the following single-kanji word /hune/ (舟) resulting in the hybrid /o-hune/ as in (6).

Note that in present-day Japanese, the

Table 3

Examples of Perseverative Blends (2)

Stimulus	Pronunciations		Responces	
(1) 材料 "material"	/zai-ryou/	→	/zai-ryou/	(cr)
(2) 夕刊 "evening paper"	/yuu-kan/	→	/zai-kan/	(pb)
(3) 労働 "labor"	/rou-dou/	→	/zai-rou/	(pb)
(4) 運送 "transportation"	/un-sou/	→	/un-sou/	(cr)
(5) 電池 "battery"	/den-ti/	→	/den-ti/	(cr)
(6) 夢路 "dream"	/yume-zi/	→	/den-ti/	(tp)
(7) 奉行 "magistrate"	/bu-gyou/	→	/den-kou/	(pb)
(8) 極上 "extra quality"	/goku-zyou/	→	/den-kyoku/	(pb)

tp = total perseveration

Note: /kou/ and /kyoku/ in (7) and (8) are another legitimate readings of 行 and 極 respevtively.

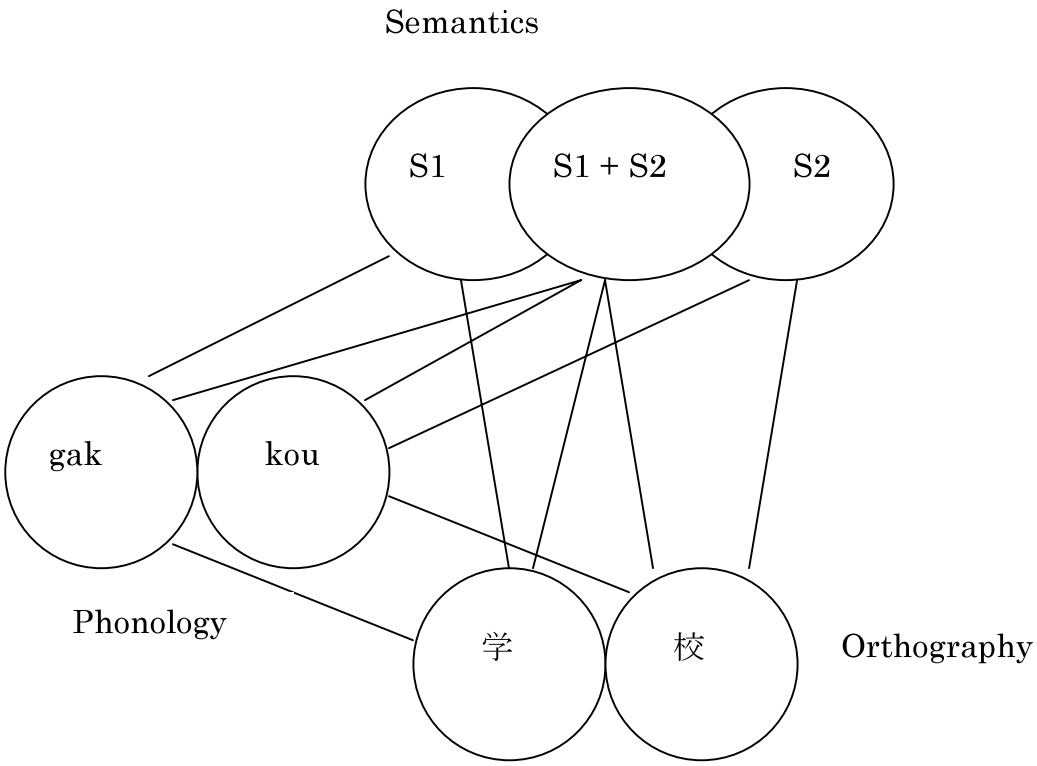

Figure 1. Adapted from Zhou et al. (1999)

Table 4

Examples of Perseveration of *Kana* Prefix

Stimuli	Pronunciation		Response
(1)お 茶	/o-tya/	→	/o-tya-garashi/(n)
"tea"	POL-tea		
(2)茶碗	/tya-waN/	→	/o-tya-garashi/ (tp)
"bowl"	tea-bowl		(total perseveration)
(3)楽器	/gak-ki/	→	/raku-tya/(pb)
"musical instrument"	music-instrument		
(4)水泳	/sui-ei/	→	/o-tya-garashi/ (tp)
"swimming"	water-swimming		
(5)黄色	/ki-iro/	→	/o-ki-iro/(pb)
"yellow"	yellow-collor/o-fune/		
(6)舟	/hune/	→	/o-hune/(pb)
"boat"	boat		

n = neologism

Table 5

Examples of Suffixal Perseveration

Target	Respons
(1) 現代 “modern age” /geN-dai/	→ /geN-dai/(cr)
(2) 現代的 “modern” /geN-dai-teki/	→ /geN-dai-naori/(n)
(3) 文化 “culture” /buN-ka/	→ /buN-ka/(cr)
(4) 文化的 “cultural” /buN-ka-teki/	→ /buN-*ka-na*ori/ (n)
(5) 個人的 “individualistic” /ko-ziN-teki”	→ /geN-dai-naori/ (tp)
(6) 自主 “autonomy” /zi-syu/	→ /zi-syu-teki/(pb)
(7) 国際 “all nations” /kokusai/	→ /koku-sai-teki/ (pb)
(8) 理想 “ideal” /ri-sou/	→ /ri-sou-teki/ (pb)

politeness morpheme お /o/ is closely connected to the stem in such common nouns as お茶 /o-tya/, where 茶 /tya/, though a single character word, rarely used without the morpheme. Thus this word may well be stored in a lexicon as a firm lexical unit. Even in this case, in parallel with the whole word activation, there occurred a sublexical phonological activation that led to the carryover of the component character sounds.

Incidentally, note that in (3) of Table 4, the component character 茶 /tya/ was also persevered, with the correct 楽 器 /gak-ki/ “musical instrument” read as the hybrid /raku-tya/, in which /raku/ is another legitimate reading of the first character 楽.

Another interesting instance of perseveration is the carryover of the suffixal morpheme 的 /-teki/, which productively derives adjectives from nouns (e.g., 文化 /buN-ka/ “culture” → 文化的 /buN-ka-teki/ “cultural”). Here is a look at Table 5:

Conclusion

In this article, we have focused on the morphemically-based perseverative blends that SM exhibited while reading two-character words. These perseverations provide empirical evidence for the crucial role of orthographic information in the recognition of compound words, and further for models such as a multilevel interactive activation model and a interactive constituency model, which distinguish at least the grapheme/ morphemic and the whole-word layer that are associated by the network of spreading activation. It follows from these models that phonological activation occurs for individual morphemes. In conjunction with the abnormal activation theory, this accounts for SM's perseverations; when the activation of all the component kanji is too weak, a whole-word phonology will persevere ((a-i) in Table 1). If one *kanji* (morpheme) is not activated enough to emerge, a past morpheme will carry over to fill in the gap, thus accounting for the hybrids of (b) of Table 1. If the activation of an affix is relatively strong, it will persevere to be affixed to the present word, resulting in the (c)-type blends in Table 1.

Thus we have actually witnessed morphemically based perseverations, a theoretical possibility predicted from the abnormal activation theory of perseveration and the models that assume links between morphemes and phonology.

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